Final Report: Marine Bioacoustics: Back to the Future

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Award Number: N00014-08-1-0359

LONG-TERM GOALS

The primary goal of our project has been to provide advanced undergraduates, graduate students, and postdoctoral investigators with a broad understanding of ocean acoustics as well as the techniques used to study the ecology of marine animals *in situ*. By bringing together many of the top researchers in marine bioacoustics, biological oceanography, and marine biology, we provide students with a unique opportunity to work side by side with world experts using state-of-the-art tools and technologies. A secondary goal of the project is to provide a setting for developing and testing new technologies. In this manner, it serves as a research magnet, attracting leading scientists to conduct their own research in a creative teaching and learning environment that catalyzes interactions across the various disciplines associated with Bioacoustical Oceanography.

OBJECTIVE

To provide students with a broad understanding of the acoustic techniques used to study the distribution and behavior of marine animals in the context of their physical/chemical/biological environment.

APPROACH

Through lectures, demonstrations, and field exercises, we provided students with a unique opportunity to learn and work side by side with top scientists using state-of-the-art bioacoustic tools and techniques. During winter courses, we provided students with hands-on opportunities to investigate active acoustic methods for studying aspects of zooplankton and fish ecology and passive acoustic methods for studying humpback whale ecology. During summer courses, we provided students 1.) with a strong conceptual understanding of marine bioacoustics theory through lectures and laboratory exercises, and 2.) practical hands-on experience through field experiments and cruises.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2013		**00-00-2013 to 00-00-2013**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Final Report: Marine Bioacoustics: Back to the Future	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Kohala Center,P.O. Box 437462,Kamuela,HI,96743**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**3**	

WORK COMPLETED

Highlighted activities conducted over the five years of our grant include the following:

1. Three zooplankton acoustics cruises to in Saanich Inlet, BC Canada to demonstrate a.) how the forward problem can be used to groundtruth acoustic data, and b.) how survey data can interpolated to generate 3-dimensional assessments of zooplankton distributions.
2. A experimental study in Saanich Inlet to test the hypothesis that strobe lights on a MOCNESS sampling system reduces or eliminates net avoidance by euphausiids,
3. Field trials along the Kohala Coast of Hawai Island to test a new, multi-ferquency echo sounder developed for use with Wave Gliders,
4. A fisheries acoustics cruise to demonstrate the methods used for conducting marine predator-prey studies using acoustics to define prey fields.
5. A passive acoustics exercsie at Lime Kiln Lighthouse on San Juan Island to calibrate its hydrophone array and evaluate its performance in localizing and tracking orcas,
6. A passive acoustics exercise along the Kohala Coast in which three Wave Gliders were deployed with hydrophones to localize and track vocalizing humpback whales.

Over the five years of our grant we ran five, two-week winter courses (2009-20013); two, five-week summer courses (2009, 2011), and one, four-week training workshop (2103). The distinction between the two summer courses and the one training workshop is that the latter was not offered for academic credit. During these courses and the workshop, we have trained a total of 111 students, broken down as follows:

Total Undergraduate Students: 72

Total Undergraduate Women Students: 43

Total Undergraduate Minority Students: 8

Total Graduate Students: 34

Total Graduate Women Students: 22

Total Graduate Minority Students: 2

Total Postdocs: 5

Total Women Postdocs: 2

RESULTS

Highlights of student experiences include:

1. Student project to evaluate multi-frequency inversion methods demonstrated sensitivity to various assumptions and suggested mechanisms for constraining solutions to improve confidence,

2. Successful experiment demonstrating that strobe lights can eliminate net avoidance by euphausiids,
3. Successful demonstration of Wave Glider's capability for collecting multi-frequency acoustic data.
4. Successful demonstration that individual humpback whales can be localized and tracked with hydrophone array deployed on Wave Gliders.

IMPACT

Students from around the world come to these courses because they provide the best training available in Marine Bioacoustics. The student participants from the past five years bring our total number of students since 1993 up to 297 students from 32 different countries. Alumni from our courses have become national and international leaders in the fields of Marine Bioacoustics and Bioacoustical Oceanography, and we are now training the second generation of students in this field (training the students of our former students).

RELATED PROJECTS

None